

## CHAPTER V - RESEARCH & DEVELOPMENT SUMMARY

### 1. GENERAL

Part of the mission of the Joint Typhoon Warning Center is to conduct applied tropical cyclone research as time and resources permit; the objective of this research being the improvement of operational forecasts. This year, due to the installation of the Naval Environmental Display Station (NEDS), the JTWC staff devoted considerable time and effort in converting and updating operational programs and streamlining operational procedures for compatibility with the NEDS. The following abstracts summarize the year's research and development projects completed or still in progress.

### 2. TROPICAL CYCLONE MINIMUM SEA LEVEL PRESSURE - MAXIMUM SUSTAINED WIND RELATIONSHIP

(Shewchuk, J. D and Lubeck, O. M., FLEWEACEN/JTWC)

The pressure-wind relationship developed by Atkinson and Holliday, Tropical Cyclone Minimum Sea Level Pressure - Maximum Sustained Wind Relationship for Western North Pacific (FLEWEACEN TECH NOTE: JTWC 75-1), is a primary tropical cyclone intensity determination tool used for JTWC operations. The current research is an attempt to update and refine the Atkinson and Holliday study using the original data plus new data from 1975 to present. The current regression equation will be re-evaluated using new cases as an independent data set.

### 3. EQUIVALENT POTENTIAL TEMPERATURE/MINIMUM SEA LEVEL PRESSURE RELATIONSHIPS TO FORECASTING TROPICAL CYCLONE INTENSIFICATION

(Hassebrock, A. W. and Dunnavan, G., FLEWEACEN/JTWC)

The relationship between equivalent potential temperature at 700 mb in the center of developing tropical cyclones and associated intensity changes was first explored by Sikora (ATR 1975) with a follow-on study by Milner (ATR 1976). These two studies produced conflicting results, but a subsequent study by Hassebrock (ATR 1977) showed that there was a relationship between changes in equivalent potential temperature and subsequent changes in tropical cyclone intensity. The tropical cyclones of 1976-78 have been used to evaluate the relationship and there is evidence that the techniques developed by Hassebrock have some merit. In order to widen the data base, the techniques will be evaluated for the 1979 tropical cyclone season, and also for tropical cyclones occurring prior to 1976.

### 4. OBJECTIVE TROPICAL CYCLONE INITIAL POSITIONING WITH A WEIGHTED LEAST SQUARES ALGORITHM

(Lubeck, O. M. and Shewchuk, J. D., FLEWEACEN/JTWC)

Recent studies indicate tropical cyclone forecast errors through 72 hours can be reduced by more accurate initial warning position estimates. This study is an attempt to develop an objective and standardized method of determining initial position based on all available fix information and their respective accuracies. The method employed is a least squares fit to the available fix data with a weighting scheme which is inversely proportional to the stated fix accuracies. This method can also be extended to objectively determine tropical cyclone best tracks.

### 5. ESTABLISHMENT OF THE JTWC TROPICAL CYCLONE DATA BASE

(Curry, W. T., FLEWEACEN/JTWC)

A data base of climatological data related to each tropical cyclone in the western North Pacific, Arabian Sea and Bay of Bengal from 1966 through 1978 is being established on FNWC computer mass storage systems. Included are 6-hour best track positions (intensities, direction and speed of movement); 24-, 48-, 72-hour objective technique forecasts and official forecasts of JTWC; and tropical cyclone fix data (position, intensities, platform, etc.). This data will be maintained on disk and tape files at FNWC Monterey, California and updated annually.

### 6. NEDS/COMPUTER APPLICATIONS

(Staff, FLEWEACEN/JTWC)

The advent of the Naval Environmental Display Station (NEDS) at FLEWEACEN Guam has provided the JTWC access to the large general purpose computer system at FNWC. Impact of the NEDS on operations at the JTWC has been studied and a NEDS implementation plan has been drawn up which includes existing operational requirements as well as future capabilities allowed by the NEDS.

Considerable automation of time consuming computational tasks has been accomplished with computer programs written to execute at FNWC. Existing post-analysis programs originally coded to execute on FWC Guam's CDC 3100 computer have been converted to execute at FNWC. In addition, numerous new features have been added to the programs.

NEDS graphics capability is being developed to depict forecast tracks from objective techniques. Establishment of a tropical cyclone data base on FNWC mass storage devices has been initiated and contract work has resulted in conversion of JTWC's objective techniques to execute on FNWC computers. Considerable effort has been expended to evaluate and monitor the program conversions.

## **7. BASIC STREAMLINE ANALYSIS AND TROPICAL CYCLONE FORECASTING TECHNIQUES GUIDE**

(Guay, G., FLEWEACEN/JTWC)

A case study taken from an active tropical cyclone period has been initiated. The study will be worked into a guide to train new assignees in streamline analysis and the use of all available tropical cyclone forecasting techniques. The guide will also be used in STORMEX training (training scenarios for Det 4 HQAWS, 54 WRS, JTWC and AJTWC personnel).

## **8. STATISTICAL EVALUATION OF JTWC OBJECTIVE TECHNIQUES**

(Lubeck, O. M., FLEWEACEN/JTWC)

Present forecast aids used by the typhoon duty officer include many objective techniques. Little information beyond annual average errors, however, is known about the techniques. A statistical evaluation is being accomplished in hopes of finding systematic biases and confirming/denying previous subjective determinations.

## **9. JTWC FORECAST CONFIDENCE STATEMENTS**

(Hassebrock, A. W., Ihli, C. B., Jr. and Lubeck, O. M., FLEWEACEN/JTWC)

JTWC developed and implemented procedures for computing objective, probability confidence statements as a result of requirements stated at the 1978 Tropical Cyclone Conference. Forecast error probabilities were appended to Prognostic Reasoning Messages during the 1978 season. An evaluation of these confidence statements and Strike Probability Program (STRIKP) information (provided by NEPRF and FNWC Monterey) was performed and published in the 1979 Pacific Command Tropical Cyclone Conference Proceedings Report.

## **10. THE TRANSITIONING OF TROPICAL CYCLONES TO EXTRATROPICAL CYCLONES**

(Guard, C. P., FLEWEACEN/JTWC and Brand, Samson, NEPRF)

Results of the examination of the post-recirculation transition of tropical cyclones to extratropical cyclones were published as NAVENVPREDRSCHFAC Technical Report TR 78-02, Extratropical Storm Evolution from Tropical Cyclones in the Western North Pacific Ocean in July 1978. Capt. Guard, now of AFGWC, Offutt AFB, NE, presented further results at the 12th Technical Conference on Hurricanes and Tropical Meteorology in April 1979 at New Orleans, LA. His report was entitled The Intensity of Recurring Western North Pacific Tropical Cyclones: A New Look. During 1979, the JTWC staff will be evaluating the rules-of-thumb generated from the research results.